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ABSTRACT

This report describes a project which commenced in 1980 at the Open University in England, the object of which was to provide blind Open University undergraduate students with home-based computing facilities through the use of low-cost commercially available microcomputers and speech synthesizers. The development of computer programs that incorporate synthetic speech output routines, the configuration of a TRS-80 computer for computer-assisted learning (CAL) that incorporates synthetic speech output, and BASIC programming employing speech output facilities are discussed. Three figures illustrating the hardware configurations for speech output CAL accompany the text. (Author/JL)

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COMPUTER-ASSISTED SUPPORT

FOR BLIND STUDENTS

PROJECT REPORT

CAL for blind students: some recent developments

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CAL for blind students: some recent developments

During the past 2 years, progress has been made in providing blind Open University students with access to computing facilities through the use of synthetic speech. Initial developments have concentrated on a low-cost, microcomputer/speech synthesizer system that is suitable for the home environment.

CAL plays an important role in the Open University's distance teaching. Access to this facility is mainly through teletype terminals at study centres or summer schools. At present, this means of access is prohibitive for the blind unless an optical to tactile conversion device is used, or the assistance of a sighted person is available. Neither technique is completely satisfactory and, generally, leads to blind and visually handicapped students avoiding courses where access to computing facilities is an essential component.

Current Project

A project 'CAL for blind students' was initiated in 1980 as part of the 'Microcomputers and Teaching' research programme.

The project had 2 principal objectives:

1. The use of low-cost, commercially available hardware (Microcomputer and speech synthesizer)
2. The modification of existing software to provide all output through synthetic speech.

Practical Problems

From the outset it was decided to involve blind students at the earliest opportunity. This decision was based on the argument that it would be more difficult to develop a methodology associated with using a computer without visual output than the generation of synthetic speech under software control. This has proved subsequently to be the case.

Associated with this decision were a number of practical problems that needed to be considered in the context of home use of a microcomputer by a student:

- | | |
|------------------------------|--|
| (a) <u>Keyboard</u> | no physical modifications made; however, the need to protect against invalid or incorrect entries was recognised as an important feature to be incorporated into computer programs. |
| (b) <u>Loading Programs</u> | a cassette system was chosen to reduce cost. The cassette was modified to give an audible signal during program loading ie. to overcome the loss of the screen prompts. |
| (c) <u>Running a Program</u> | as the voice synthesizer cannot be active until a program is loaded, the number of key entries to initialise the system are kept to a minimum (less than 10 characters to be typed). |

(d) Repeat Output

the facility to repeat speech output is important - the largest and most accessible key, the space bar, was chosen for this purpose.

(e) Data entry or change

data entries are buffered to allow translation into spoken format, validation and editing prior to entry into main program. The number of keys typed to achieve this are kept to a minimum.

Computer Programs

The incorporation of speech output into a computer program is relatively straightforward. Speech synthesizers that require phoneme input are usually interfaced via a parallel port, and the ASCII characters representing the phonemes output from the program to specific memory locations that are matched to a parallel port. Alternatively, speech synthesizers that accept text directly (translation from text to phonemes in the synthesizer) are usually interfaced via a serial interface. An RS-232 driver routine can then allow LPRINT statements to be used to output text. In either case, there is only a small amount of software modification required to change from screen to speech synthesizer output. However, in the former case text has to be incorporated into the computer program as phonemes.

The main task in preparing computer programs with synthetic speech as the output medium is the development of a methodology for a computer system that has no visual output, and in a situation where keyboard errors may be high when used by a blind person.

In practice it has been found helpful to use dictionary/conversion software for program development. This software has several functions. Firstly, it translates BASIC statements written for VDU output to a format suitable for speech output. Secondly, appropriate subroutines are added which provide modified input and output routines, error messages, and incorporate the speech facilities. Finally, text is translated into phonemes if required.

An example of a conversion of an input statement is:

Source Program

INPUT "value for x" ;X

Object Program

VZ\$ = "v99I&((UU Foor 43 + Kos":
GOSUB 50000: BZ\$ = 1 :
GOSUB 50100: X = VAL(BZ\$)

The first subroutine is for speech output of the string, and includes a repeat speech facility. The second subroutine incorporates input of data, translation to speech format, and changing data in the event of typing errors. Finally, the value for X is returned to the main program. This technique was published as a paper for the CAI81 conference?

Computer-assisted Learning

The configuration shown in figure 1 has been used by blind Open University students during trials in 1981. It is based on a TRS-80, model I micro-computer (16K) and uses a phoneme input speech synthesizer. This configuration

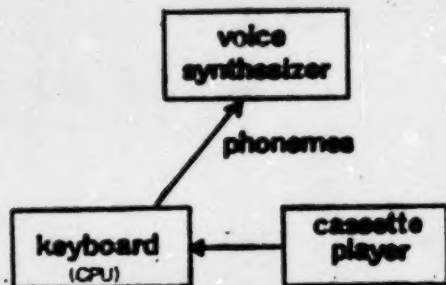


Fig. 1

computer-assisted learning

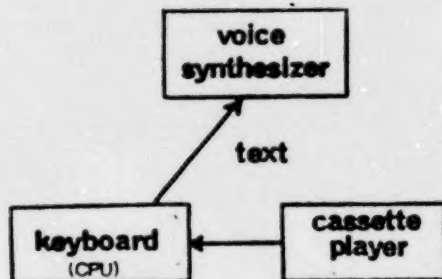


Fig. 2

computer-assisted learning
and
programming (BASIC)

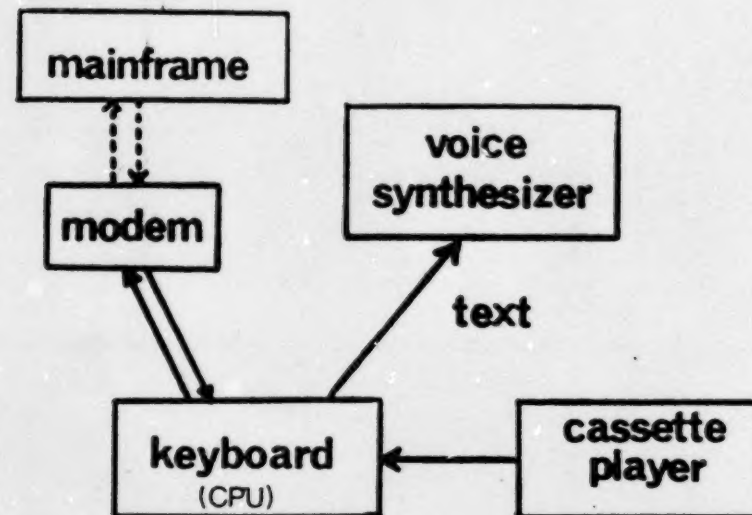


Fig. 3

computer-assisted learning
and
programming (BASIC)
plus
mainframe software

is suitable for CAL programs that require only a limited vocabulary, as the text has to be prepared in a phoneme format prior to a program being made available. Although this has obvious limitations, it has proved to be successful in meeting specific applications.

A copy of the computer program on cassette is sent to a student. The program is loaded via the cassette recorder. In addition, an audio cassette is sent on which instructions in using the program are recorded.

Programming (BASIC)

During the latter part of 1981, it became possible to offer BASIC programming facilities on the microcomputer. This situation arose when a low-cost, text to speech synthesizer (VOTRAX) became available. The alternative configuration is shown in figure 2.

Again it has been necessary to develop a methodology to support programming in an environment without visual output. One example of the techniques used is shown at the input stage where characters are typed at the keyboard. For the novice it is helpful to have a spoken output after each character is typed; for a more experienced person this is not necessary. To accommodate both needs in the same program, a timing subroutine checks the rate of typing: if it is below a pre-set rate, each character is spoken; above the pre-set rate the speech is suppressed.

Currently, the modified BASIC interpreter is under-going trials.

Mainframe Access

Ideally, it is hoped that blind students will be able to access the software made available to all students on the DEC-20 mainframe. To achieve this it is necessary to use the configuration shown in figure 3. A dual serial interface has already been developed for this purpose, and communication software will shortly be available that will allow preliminary trials in student's homes to take place.

Conclusion

CAL for blind students has been shown to be possible through the use of synthetic speech. Equally important has been the use of low-cost, commercially available hardware - the lack of this feature has prevented many facilities in the area of special education being made available to potential users. With the cost of microcomputers and speech synthesizers continuing to fall, this technique should find widespread use for blind people who need access to computing facilities.

1. Microcomputers and Teaching. Progress report 1981.
2. Computers and Education, Vol.6, 1982; CAL Research Group Technical Report No.10, 1981.